

DEPARTMENT OF THE AIR FORCE, THE ARMY, THE NAVY,
AND TRANSPORTATION
Washington DC 20330-5000

CHANGE 1
AFP 164-4
TB MED 289
NAVMED P5115
COMDTINST M6320.20
1 November 1991

This copy is a reprint which includes current
pages from Change 1.

Aeromedical Evacuation
A GUIDE FOR HEALTH CARE PROVIDERS

AFP 164-4, 19 September 1986, is changed as follows:

Page-Insert Changes. New or revised material is indicated by a ★.

Remove	Date	Insert
3, 4	19 Sep 86	3 thru 4.1
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No. of Printed Pages: 8

Distribution:

Air Force: F

Army: Active Army, ARNG, USAR: To be distributed in accordance with DA Form 12-37-E, Block 1761,
requirements for TB MED 289, Aeromedical Evacuation: A Guide to Health Care Providers

Navy: Ships and Stations Having Department Personnel

Coast Guard: DOT Initial Distribution Section,
Ardmore-East Business Center, 3341Q - 75th
Avenue, Landover, MD 20785, M/F: USCG



0510LP1001001

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Aeromedical Evacuation
A GUIDE FOR HEALTH CARE PROVIDERS

This pamphlet provides guidance to physicians and other health care providers who select and prepare patients for transport on all types of aeromedical evacuation (AE) aircraft. It applies to all Department of Defense (DOD) facilities using the AE system, including Air National Guard and Air Force Reserve units and members.

A brief description of the AE organization, types of aircraft used, and the AE environment provides baseline capability and insight into the AE system. Emphasis is placed on the originating physician's responsibility and the medical aspects of patient preparation. A checklist is included to assist in adequately preparing the patient for flight (see attachment 1).

This publication implements Standard NATO Agreement (STANAG) 3204 and should be used in conjunction with tri-service regulation AFR 164-3/AR 40-40/BUMEDINST 4650.2A, Documentation Accompanying Patients Aboard Military Common Carriers; AFR 164-5/AR 40-535/OPNAVINST 4630.9C/MCO P4630.9A, Worldwide Aeromedical Evacuation; and AFR 168-11/AR 40-350/BUMEDINST 6320.1D/(PHS) BMS CIR NO 75-15/CG COMDT INST 6320.8A, Medical Regulating To and Within the Continental United States.

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Supersedes AFP 164-4, TB MED 289, NAVMED P5115/CG-436, 13 September 1972. (See signature page for summary of changes.)

No. of Printed Pages: 15

OPR: SGPA (CMSgt J. Casteel)

Approved by: Maj Gen William H. Greendyke

Writer-Editor: D. Britford

Distribution: (See page 14)

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Section A—General Information

1. Organization. AE is a part of the overall global Military Airlift Command (MAC) mission delegated to the Air Force by the Department of Defense (DOD). Worldwide AE operation and management is consolidated and centralized by HQ MAC and tasked to the 375 Aeromedical Airlift Wing (AAW) located at Scott AFB IL. The 375 AAW/SG is the central medical manager for worldwide AE missions. There are three active duty and seven Air Force Reserve (AFRES) aeromedical evacuation squadrons (AES) under the 375 AAW that provide 24-hour per day, 7 days per week aeromedical airlift support for the entire world during peacetime. One additional active duty tactical AE squadron and 23 additional MAC-gained AFRES and Air National Guard (ANG) AE units are activated upon mobilization. The three active duty squadrons are tasked to provide day-to-day AE service worldwide. Command and control is maintained through their aeromedical evacuation control centers (AECC). These squadrons are the 57th, 2nd, and 9th AESs.

a. 57th AES (Scott AFB IL). Controls missions in the continental United States (CONUS), strategic missions between CONUS and near offshore areas (including Alaska, South America, Central America, and the Caribbean region) and strategic AE missions between CONUS, Europe, and the Pacific, in coordination with the AECCs of the 2nd and 9th AESs.

b. 2nd AES (Rhein-Main AB GE). Controls European theater AE missions, including Europe, Africa, the Middle East, to the western border of Iran, and strategic missions originating from Europe to CONUS, in coordination with the 57 AES/AECC.

c. 9th AES (Clark AB RP). Controls Pacific theater AE missions, including the Pacific and Asia from the west coast of the United States to the eastern border of Iran, and strategic missions originating from the Pacific to CONUS, in coordination with the 57 AES/AECC.

2. MAC's AE Mission. The primary mission of MAC's AE system is to evacuate patients from the battle zone to definitive care facilities, thus relieving the combat commanders of patient care and protection responsibilities. In peacetime the AES maintains readiness by training crews, exercising the command and control system, and testing equipment. The peacetime movement of authorized DOD personnel to and from major medical facilities for diagnosis and treatment is a by-product of readiness training.

3. Types of AE Aircraft. Three primary aircraft are used in aeromedical airlift: C-9A, C-141B, and C-130.

a. C-9A Nightingale. The C-9A is a military version of the DC-9 commercial aircraft. It is a single purpose aircraft used over short and medi-

um range distances. The C-9A is the only aircraft specifically designed for AE and is the best available aircraft for the aeromedical transfer of patients in existence today. The modern features of the C-9A include a special care area (intensive care and isolation of infectious diseases), medical service area, central storage area, medical crew stations, and communication and call systems. It can carry up to 40 patients in mixed litter and ambulatory configuration.

b. C-141B Starlifter. This multipurpose aircraft is primarily designed for airlifting cargo. It is used for strategic AE missions in peacetime and wartime. In wartime and emergency situations, it can carry troops, supplies, and cargo into a combat or troubled area, and after reconfiguration, return with sick and injured patients. The configuration or adaptation of this aircraft, enables the transport of large numbers of patients. It can be configured to carry up to a maximum of 103 litter patients, at least 146 ambulatory patients, or any mix of litter and ambulatory patients.

c. C-130 Hercules. Like the C-141B, the C-130 is a multimission aircraft. It is the largest turbo prop driven cargo aircraft in the Air Force inventory. It will be used as the primary aircraft for tactical AE purposes in the combat zone, and is a backup for C-9As in the three intratheater areas. It can carry up to 74 litter patients, 86 ambulatory patients, or any mix of litter and ambulatory patients.

d. Other Aircraft. In unusual situations, C-5, CT-39, C-12, C-21, and KC-135 aircraft can be used. Also, the Civil Reserve Air Fleet (CRAF) may be required to transport ambulatory patients during wartime.

4. Selection of Patients. The physician at the originating medical facility must determine which patients require AE for more definitive treatment. Although there are no absolute contraindications to AE, patients should be as medically stable and as fully protected against the stresses imposed by flight as possible (see sections C and D).

5. Classification of Patients. Patient classification is determined by the physician at the originating facility according to tri-service regulation AFR 164-5/AR 40-535/OPNAVINST 4630.9C/MCO P4630.9A. Patient classification is critical in identifying to the medical aircrew patients who must travel on a litter or in ambulatory status, and whether able to assist themselves during an aircraft emergency. During contingency operations or anytime it is the classification categories under

AFR 164-5 originating medical treatment facilities' responsibility to manifest patients by using a DD Form 601, Patient Evacuation Manifest, the patient and attendant classification codes listed in AFR 164-5/AR 40-535/OPNAVINST 4630.9C/MC P4630.9A will be used. During normal peacetime operations, the following patient and attendant classification codes will be used:

a. Class 1—Neuropsychiatric Patients:

(1) Class 1A—Acutely ill psychiatric patients who require close supervision. These patients must be sedated before a flight, restrained by leather ankle and wrist restraints, dressed in hospital clothing, and on a correctly prepared litter.

(2) Class 1B—Moderately ill psychiatric patient. These patients should be sedated before a flight, dressed in hospital clothing, and on a correctly prepared litter.

NOTE: Restraints will be provided by the originating facility and available for use if necessary.

(3) Class 1C—Ambulatory psychiatric patients who are cooperative and have proved reliable under observation.

b. Class 2—Litter Patients (Other Than Psychiatric).

NOTE: If patients require a rest during a long flight because of recent surgery or have difficulty safely ambulating, they should be classified as litter patients.

(1) Class 2A—A litter patient who may not, or cannot, ambulate and who is dependant on another person in an aircraft emergency. This patient should be dressed in hospital clothing and be on a properly prepared litter.

(2) Class 2B—A litter patient who is able to ambulate and sit in an aircraft seat if a seat is available. This patient is enplaned and deplaned on a properly prepared litter and should be dressed in hospital clothing.

c. Class 3—Ambulatory Patients (Nonpsychiatric). These patients may require some medical treatment, care, assistance, or observation during flight.

d. Class 4—Ambulatory Patients (Nonpsychiatric). Patients who require no care during flight.

e. Class 5—Medical Attendant (Physician, Nurse, or Corpsman). Attendants who are in addition to the basic aeromedical crew.

f. Class 6—Nonmedical Attendant.

6. Movement Precedence. The movement precedence will determine how quickly the patient will be picked up and moved by the AE system. It is determined by the physician at the originating facility. Precedence categories are urgent, priority,

and routine:

a. **Urgent**—Patients categorized as “urgent” require emergency movement to save life or limb or prevent serious complications. Aircraft will be launched or diverted to pick up and deliver the patient to the destination as soon as possible.

NOTE: Psychiatric or terminal patients are not considered “urgent” patients.

b. **Priority**—Patients categorized as “priority” require prompt medical care not available locally. Patients will be picked up within 24 hours and delivered with the least possible delay.

NOTE: Patients may be subject to several en route stops.

c. **Routine**—Patients will be picked up within 72 hours and moved on routine or scheduled flights. Because of the routing of the AE system, patients may be required to fly for more than 1 day and remain overnight in an aeromedical staging facility (ASF) or holding ward.

d. **Special Patient.** A “special patient” is any patient considered to be at significant risk while being aeromedically evacuated. A “special patient” may be of routine precedence whose movement may not be time sensitive, but who may require special expertise or teams, special nursing care, special equipment, or special procedures. The AECC identifies special patients based on clinical facts and concerns. The AECC discusses each case with the 375 AAW/SG or the respective theater validating and consulting flight surgeon before the move. Urgent and priority precedence may automatically designate special patients. The Flight Clinical Coordinator, a nurse with special training and experience in operational and medical aspects of aeromedical evacuation, coordinates medical preparation for special patients.

7. Role of Validating and Consulting Flight Surgeons. The 375 AAW/SG is the central medical manager and validator or consultant for worldwide AE of DOD patients or battle casualties. However, within the European Command (EUCOM) and the Pacific Command (PACOM) regions, the responsibility for validation and consultation is delegated to the respective US Air Force theater surgeons. The 375 AAW/SG must remain actively involved in, and informed of, all significant day-to-day happenings in AE. Each AECC will seek validation for all urgent patients and consultation for all priority and special category patients from their designated validating or consulting flight surgeon before such patient moves are planned and executed. The validation or consultation process includes sharing medical

information from the originating physician, and achieving mutual agreement and coordination of a suitable method of movement. Validating and consulting flight surgeons are familiar with all aspects of the AE system, including resources, operations, capabilities, and limitations. They help integrate the originating physician’s identified needs for his or her patients with available AE capability for transfer of critically ill or injured patients. They also serve as consultants to the AECCs for other medical concerns relating to AE; for example, assistance with in-flight medical emergencies. Locations and responsibilities of validating and consulting flight surgeons are:

a. **CONUS.** The 375 AAW/SG, Scott AFB IL, is responsible for CONUS AE missions and strategic AE missions originating in the Azores, Greenland, Iceland, Alaska, South and Central America, Bermuda, and the Caribbean. The SG coordinates with the respective US Air Force theater surgeons and AECCs regarding strategic missions between CONUS and Europe and the Pacific.

b. **Europe.** In EUCOM, the flight surgeons at the USAF Clinic Rhein-Main AB GE, are designated by the USAFE surgeon to assist the 2nd AES with AE requirements in Europe, Africa, and the Middle East.

c. **Pacific.** In PACOM, the flight surgeons at USAF Regional Medical Center Clark AB RP, and the PACAF/SG flight surgeons are designated by the PACOM surgeon to assist the 9th AES, Clark AB RP, with AE requirements in the Pacific Ocean region, most of the Indian Ocean region (to 60° East longitude), Far East, Near East, Central Asia, and Australia.

d. **Alaska.** Initial validation by the Alaskan Air Command Surgeon (AAC/SG).

e. **South and Central America.** Initial validation by the Southern Air Division/SG (USAF Clinic Howard/SG), Panama.

8. Process of Evacuation. The process of moving a patient by air may be complex and may require as many as 5 days from the point of origin until the patient reaches the destination medical treatment facility.

a. **Wartime.** The AE system exists primarily for the wartime evacuation of patients from the battle zone (see DOD 4515.13-R). Patients are first brought from the combat zone to the forward treatment facility by ambulance or helicopter where they are initially treated and stabilized. Patients who cannot be returned to duty and who need definitive or long-term care are evacuated to

Ocean region (to 60° East longitude), Far East, Near East, Central Asia, and Australia.

d. Alaska. Initial validation by the Alaskan Air Command Surgeon (AAC/SG).

e. South and Central America. Initial validation by the Southern Air Division/SG (USAF Clinic Howard/SG), Panama.

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a rear area medical facility according to the theater evacuation policy. Patients who need Air Force evacuation are entered into the AE system from Mobile Aeromedical Staging Facilities (MASF) usually located near forward airstrip. Patients are brought to the MASF by ground ambulances or helicopters, and prepared for flight. The MASF is a 25-bed tent type facility used during wartime as a collecting point or holding ward. Medical resources are extremely limited and patients are usually evacuated within 2 hours. Depending on the extent of injury and the time required to return the individual to duty, some patients will remain in the AE system for subsequent movement to CONUS by strategic airlift (C-141). When long distances must be traveled, the patient may be required to transit one or more ASFs. The ASFs are either a series of large tents or fixed facilities, usually collocated with a medical treatment facility. They function as holding wards in both peacetime and wartime for patients awaiting further transportation while en route in the AE system. Capacity ranges between 50 and 250 beds, and turnover is rapid. At each stop the patient is evaluated before further transport.

b. Peacetime. During peacetime, oversea and CONUS DOD beneficiaries requiring more advanced diagnosis or treatment are reported to the respective AECC for the geographical area and moved within the theaters on C-9A aircraft. Because of the number of facilities serviced and people moved, patients often experience en route stops and may remain overnight at an ASF before reaching their destination. Patients from oversea areas are returned to CONUS, when necessary, on a C-141.

Section B—Role and Responsibilities of Originating Physicians

9. Patient Transportation. If a patient can be moved at all, he or she should be moved by air, *provided the originating physician gives proper attention to all aspects of the operation.* AE is generally the best mode of patient transportation over long distances. It is also the best mode of transportation in life-threatening emergencies and other time-sensitive moves when the local area lacks definitive care. The originating physician is the key element in the AE of patients. Patient care is provided according to the orders and instructions written on DD Form 602, Patient Evacuation Tag, while the patient is in the AE system.

10. Fundamental Responsibility. Preparing a pa-

tient for AE is the joint medical and administrative responsibility of the physician, the nursing staff, and the administrative staff. However, the originating physician remains fundamentally and professionally responsible for the patient who is being aeromedically evacuated. The originating physician's responsibility does not end until the patient is under the direct care of the receiving physician at the destination medical facility. AE crewmembers function during the transfer process as a nursing team responsible for implementing the patient care instructions of the originating physician.

11. Determinations Before the Movement. Before the movement request is made to the AE system, the originating physician must specifically determine:

- a. The degree of patient benefit resulting from transfer.
- b. Patient suitability for AE considering both the level of his or her stability and chance for survival during AE.
- c. The timing for transfer or precedence (Urgent [U], Priority [P], or Routine [R]).
- d. En route care required.
- e. Need for nonmedical, or medical attendants (such as a physician, a special care nurse, or a respiratory technician).
- f. Need for special medical equipment, such as a ventilator, cardiac monitor, or Stryker frame.
- g. Special medical considerations (altitude restriction, oxygen, etc.) and any medical limitations, such as limited en route stops and no overnight stops.

12. Patient Movement Request and Reporting. When a patient is selected for AE, the originating physician completes an AF Form 230, Request for Patient Transfer, or Department of Army (DA) Form 3981, Request for Patient Transfer. The reporting of routine precedence patients needing AE within CONUS is directed to the Armed Services Medical Regulating Office (ASMRO). Urgent and priority patients are reported directly to the AECC. The physician must provide accurate clinical information to the AECC on urgent, priority, special, and when indicated, routine patients to ensure a safe and successful move. Additionally, as directed in AR 49-350/BUMEDINST 6320.1D/AFR 168-11/(PHS) BMS CIR No. 75-15/CG COMDT INST 6320.8A, in unusual or emergency cases it is essential that the direct coordination required between the originating and receiving MTF be fully accomplished. This coordi-

nation includes physician to physician contact with acceptance of the patient by the receiving physician where required.

a. **DD Form 602.** This is the single most important medicolegal document that must accompany the patient to ensure appropriate care during transport. It is an abbreviated medical record originally designed for wartime use. This document is primarily used to direct en route treatment and give instructions to the AE crewmembers. It is also the form on which all treatment given en route is recorded. The following items on DD Form 602 must be completed and signed by the originating physician:

- (1) Primary and all other significant diagnoses.
- (2) Correct classification.
- (3) Proper precedence.
- (4) Orders for all en route medication and care (must be specific and legible).
- (5) Special diet, if necessary.

b. **SF Form 502, Medical Record—Narrative Summary (Clinical Resume).** This form is used for inpatient transfers. This may be the only clinical information the medical crew has time to review to make en route decisions during air transportation. This document is essential for physician review at transient, remain overnight locations, and final destination before undertaking medical intervention and management. The narrative summary should be concise, clear, and list all the significant recent and past medical facts.

c. **SF Form 513, Medical Record—Consultation Sheet (Outpatient Only).**

d. **Medical Records.** All other pertinent medical records, including inpatient and outpatient records and recent laboratory data should accompany the patient as appropriate.

e. **X rays.** All available x rays which relate to the patient's current medical condition must be sent with the patient.

Section C—Aeromedical Evacuation Environment

13. Introduction to the AE Environment. The AE environment is an isolated, hypobaric atmosphere that differs significantly from other medical treatment facilities. These differences impact on certain patients at risk, as discussed in section D.

14. Health Care Environment. The AE system has been developed using the aircraft as a vehicle to transport patients. The basic AE crew is comprised of two flight nurses and three AE tech-

nicians. Although these individuals have additional training, their function remains essentially that of a nursing service. Since the aircraft is not an optimal environment, patients must be stabilized, and physicians' orders for en route care on the DD Form 602 must be very specific. Physicians are usually not a part of the basic medical crew, and the aircraft is *isolated* from other available medical support during flight. Certain patients cannot be safely moved in this AE environment without medical crew augmentation or special arrangements. Such patients may require special care by individual experts or teams (burn, neonatal, etc.), using special equipment and special flight arrangements. The AE crew can be augmented, when indicated, by physicians, nurses, respiratory therapists, anesthetists, or other health care professionals.

15. Aircraft Environment. The aircraft presents an environment that is unique in the following areas:

a. **Temperature.** During ground operations (flight line), temperature fluctuations can be extreme; such as, summer heat and winter cold. During in-flight operations, the temperature control can be erratic on the aircraft with the possible exception of the C-9. The C-130 and C-141 cabins are often cold at altitude. When caring for special patients, such as neonates and burn cases, temperature control can be critical.

NOTE: Certain other medical conditions may be exacerbated by temperature fluctuations.

b. **Humidity.** The amount of water in the air (humidity) decreases with altitude. Humidity also decreases with extended flying time and may be less than 3 percent toward the end of a long mission. This can have a significant impact on patients with fluid balance problems (dehydration) or with respiratory embarrassment. On long flights, one should expect such problems and plan to increase fluid intake (oral or intravenous (IV)).

c. **Noise.** Noise is a problem in all aircraft; however, the C-9 is quieter than cargo aircraft due to better noise attenuation. Noise prevents monitoring of audible vital signs (blood pressure, audible alarms, auscultation). It also interferes with communications between patients and aeromedical evacuation crewmembers (AECM), as well as communications between AECMS. The C-9A has a patient call system but it is unique to this aircraft. Noise also causes psychological degradation by isolating the patient and increasing fatigue. Good preflight evaluation and alerting the crewmember of potential complications are most im-

portant.

d. Lighting. Except for the C-9, lighting is generally poor and is heavily dependent on spot lighting. This impedes the ability to observe the patient's skin color changes (pallor or cyanosis), basic vital signs (ventilation quality), and to monitor equipment (IV infusion). It also limits special procedures in flight (cut-downs, etc.). Good preflight preparation is a must.

e. Vibration. With the exception of helicopter and some C-130 operations, vibration is a minor problem. Vibration of less than 2HZ may cause motion sickness, seizures, increase ventilation and pulse rates, and increases fatigue. Vibration of 2HZ may cause dyspnea and chest pain.

f. Turbulence. Turbulence can be a significant problem for patients with fractures and spinal cord injuries. The use of stabilizing devices (Collins traction in place of swinging weights, Stryker frames, etc.) is essential. Certain special procedures are difficult in a turbulent environment; such as, starting an IV when both the patient and provider are subject to sudden movement. Again, if the patient needs the procedure, it should be performed before the patient is enplaned.

g. Psychological. Transferring patients by aircraft can have a psychological impact because of the physical separation from his or her family, unfamiliar environment, or a fear of flying. A properly informed patient is less apprehensive. A thorough preflight briefing can do much to reduce stress. Emphasis should be placed on briefing patients concerning en route stops, overnight stops, checked baggage disposition, medication requirements, etc. If deemed necessary by the originating physician, a family member can be listed as a non-medical attendant to accompany the patient to his or her destination.

16. Altitude Environment. Increased cabin altitude requires knowledge of barometric pressure changes and volume changes.

a. Barometric Pressure Changes. Barometric pressure decreases with increased altitude. The primary physiological effect of decreased barometric pressure is the concomitant decrease in inspired oxygen. At sea level, barometric pressure is 760mm Hg, of which approximately 21 percent or 100mm Hg is O₂. AE aircraft normally operates with in-flight cabin altitudes of 7,500 to 8,000 feet. Since the percentage of O₂ remains relatively constant (21 percent) in air at all altitudes, the inspired oxygen pressure can be determined for various altitudes. Table 1 gives examples of Alveolar P_{O₂} at various altitudes when breathing air.

b. Oxygen and Hemoglobin Correlation. Since most oxygen is carried by hemoglobin (Hgb), a correlation can be made between P_{O₂} of oxygen and the percent saturation of Hgb (figure 1). The sigmoidal shape (S) of the curve is well suited to physiological needs and guarantees at least 90 percent arterial blood saturation in the normal lung when the oxygen is higher than 65mm Hg (less than 10,000 feet). For a patient with significant compromise in lung ventilation or perfusion, consider adding O₂. Few patients require restrictions in aircraft cabin altitude. Such a restriction should be requested only after consultation with the validating or consulting flight surgeon.

c. Volume and Pressure Changes. Gas volume changes are physiologically significant. Volume and pressure changes are inversely related. Without cabin pressurization, the volume of a gas will double when the atmospheric pressure is halved (at about 18,000 feet) see figure 2. Because of this phenomenon, gas trapped in a closed cavity (ear or GI tract) may cause pain and discomfort. Every attempt must be made to prevent this complication before a flight.

NOTE: Individual organ systems are discussed in more detail in section D.

17. Altitude Restrictions. The patient suffering from *decompression sickness* or air embolism is the only absolute indication for altitude restriction. Such patients must be flown at sea level altitude. When tissues or vital organ oxygenation cannot be guaranteed by supplemental O₂ alone, limiting aircraft cabin altitude may be necessary. Restriction of cabin altitude may limit the actual altitude at which the aircraft can fly; such as, sea level cabin altitude in the C-9 limits flying altitude to 18,000 feet. This limitation may exact a tremendous operational cost on the system. Increased fuel consumption may cause more stops for fuel. Turbulence and adverse weather may be encountered at lower altitudes. All requests for altitude restrictions must be coordinated with the *validating or consulting* flight surgeon.

Section D—Medical Considerations in Aeromedical Evacuation.

18. Stabilizing the Patient:

a. Stabilizing a patient is the key to successful AE. An airway must be ensured, fractures splinted, hemorrhage stopped, and shock treated. Transportation of critically ill patients may require increasing the medical crew with additional medical attendants, to include physicians. Pre-

Table 1. Alveolar PO₂.

$$P_{AO_2} = P_{I_O_2} - P_{ACO_2}$$

ALTITUDE	BAROMETRIC PRESSURE P _B mm Hg	TRACHEAL*		ALVEOLAR* O ₂ mm Hg
		O ₂	CO ₂	
Sea Level	760	149	55	109
1000	732.9	143	57	103
2000	706.7	138	60	98
3000	681.2	133	63	93
4000	656.4	127	66	87
5000	632	118	70	79
Inflight Cabin	609	110	73	78
Operation	7000	108	76	70
	8000	106	79	68
	9000	106	82	66.1
	10000	100	85	61

*Values in normal individuals without supplemental oxygen.

ferably, patients should meet the following standards for AE:

(1) Stable vital signs.
 (2) Stable cardiopulmonary status.
 (3) Stable hemoglobin (50 percent N or 7 Gm) or hematocrit of at least 30 percent.
 (4) No active bleeding.
 (5) Adequate fluids and hydration.
 b. There are no absolute contraindications to AE. Any patient can be aeromedically evacuated if the proper environment and a specialized medical team are provided; such as, a patient with decompression sickness can be moved if a sea level cabin altitude is provided. A severely burned patient can be moved if proper equipment, supplies, and a specialized team are provided. However, there are certain categories of patients whose movement in the AE system may not be in the best interest of the patient, crew, and other patients if it can be avoided:

(1) Communicable infectious disease patients are not acceptable during the infectious phase unless the patient can be properly isolated and adequate protection provided for the crewmembers and others.

(2) A dying patient whose general condition is so poor that he or she is unlikely to survive the flight should not be moved. An in-flight death creates many administrative problems and may result in increased costs to the government and the family. The cost of moving these patients should be weighed against benefits derived for the patient.

(3) Terminally ill patients with questionable stability, unless accompanied by a physician attendant.

(4) A patient with acute anemia or severe chronic anemia with hemoglobin (Hgb) of less than 7 Gm or hematocrit (HCT) less than 21 percent, unless hemodynamic status is improved by fluids and blood transfusion or packed cells, etc.

(5) Patients in acute sickle cell crisis.

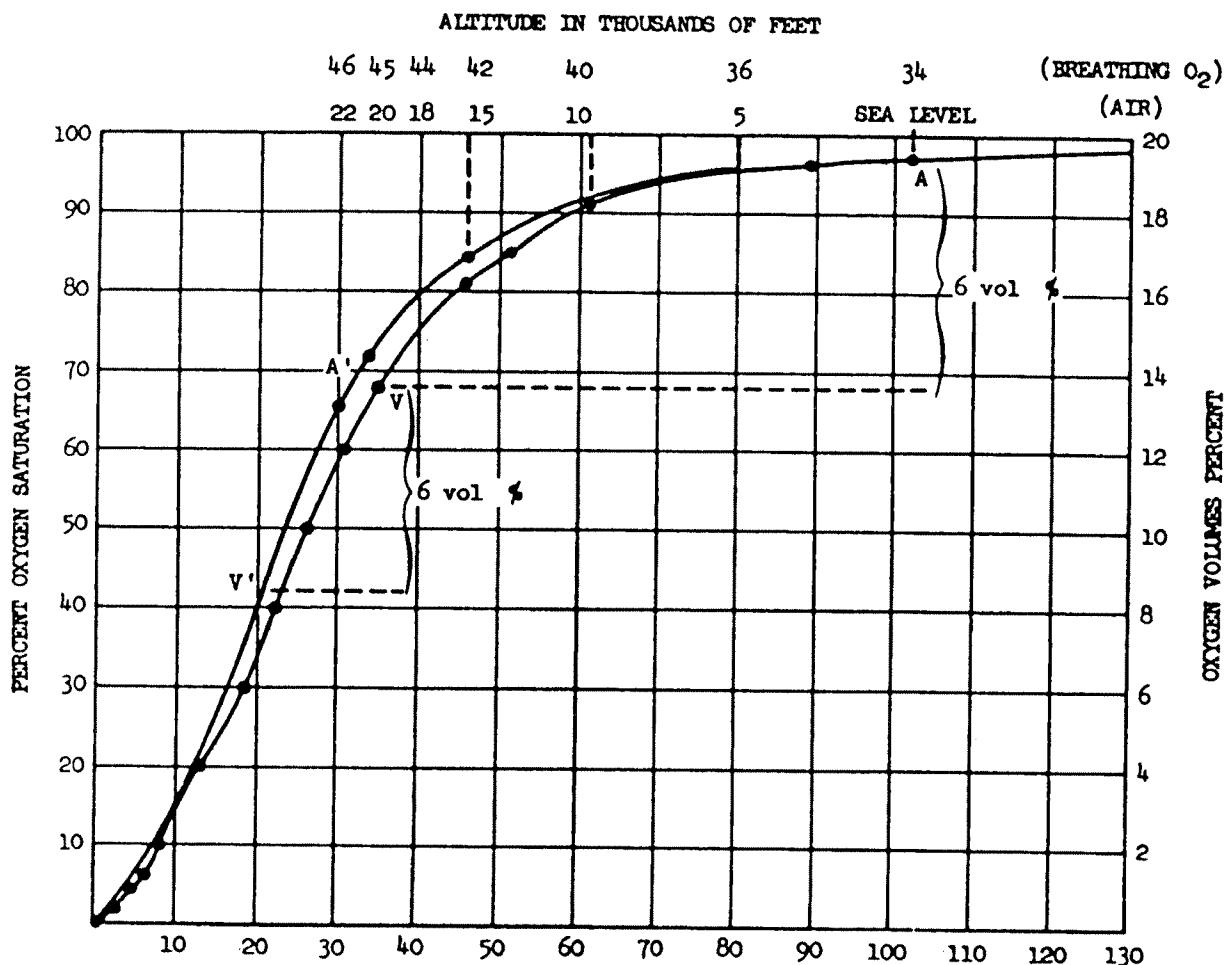
(6) Patients who have suffered a myocardial infarction within the last 10 days and who have not been free of complications for 5 days. If such patients must be moved, proper equipment (cardiac monitor) and a physician attendant are required.

(7) Patients with acute hemorrhage, GI bleeding, or bleeding secondary to blood disorders, unless the bleeding is controlled.

(8) Patients with a pneumothorax who do not have a chest tube with a Heimlich valve in place or within 24 hours of chest tube removal.

(9) Patients with a temperature above 39°C or 102.2°F of unknown etiology or untreated temperature of known etiology.

19. Review of Systems. Before reviewing specific organ systems in the in-flight environment, a review of in-flight conditions should be made. The in-flight environment may subject the patient to dehydration, fatigue, inactivity, and emotional stress (may include motion sickness). These conditions should be anticipated. The degree of stress



OXY PRESS V	OXY SAT	OXY PRESS V'	OXY SAT
1. 0	0	1. 0	0
2. 2	2	2. 30	64
3. 4	4	3. 34	72
4. 6	6	4. 46	84
5. 8	10	5. 61	91
6. 13	20	6. 88	96
7. 18	30	7. 103	97
8. 22	40	8. 130	98
9. 26	50		
10. 31	60		
11. 35	68		
12. 46	81		
13. 52	85		
14. 61	91		
15. 88	96		
16. 103	97		
17. 130	98		

The figure demonstrates the normal dissociation curve (pH 7.4) and the points on the shifted dissociation curve at various equivalent altitudes, breathing air or oxygen. The volumes percent scale is based on a blood oxygen capacity of 20 volumes percent.

Figure 1. Oxygen Dissociation Curves.

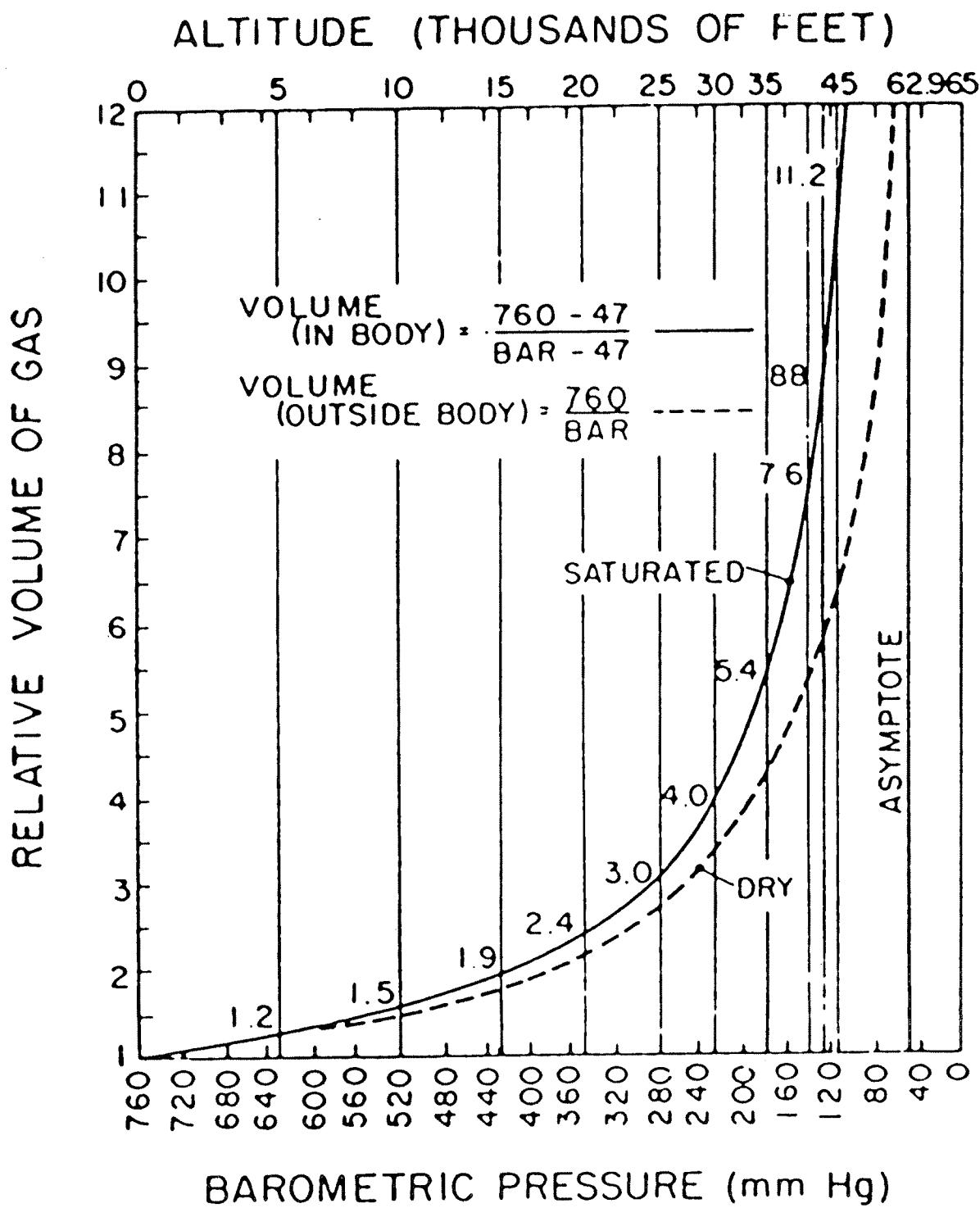


Figure 2. Comparative Volumes of Gases Inside the Body at Various Altitudes.

may vary based on the length of the flight, type of aircraft, and individual patient variables. The effects of the in-flight environment on specific organ systems are outlined below:

a. Pulmonary and Chest Disorders:

(1) **Respiratory Embarrassment.** Because of decreased P_{O_2} at altitude, certain patients with respiratory compromise may benefit from supplemental O_2 , especially on flights of long duration. A thorough preflight evaluation (to include pulmonary function tests and blood determination) is important in assessing a compromised lung patient's ability to compensate at altitude. A good predictor is the maximum voluntary ventilation. If there is evidence that a patient will have significant desaturation at altitude, supplemental O_2 should be provided in flight. Because of the low humidity, inspired air should be humidified. On rare occasions, certain patients (such as, restrictive lung disease patients) will clearly benefit from an altitude restriction. Any question concerning altitude restriction should be discussed with the validating or consulting flight surgeon.

(2) **Pneumothorax.** Patients with pneumothorax (any degree) are at increased risk at altitude because of gas expansion. Such patients must have a chest tube with a Heimlich valve (one-way flutter valve) in place before a flight.

b. ENT Problems (Otorhinolaryngology). Because of decreased atmospheric pressure and the associated volume changes, any compromise in the upper respiratory tract may prevent ventilation of the middle ear or sinuses. The resultant barotrauma can be acutely painful. Preflight preparations should include evaluation and appropriate precautionary measures, to include myringotomy if necessary. The AE crew should be made aware of any ear or sinus problems in patients.

c. Maxillofacial Injuries. These injuries are often associated with upper airway problems due to injury or secondary to fixation devices. In addition to stabilizing the airway, a variety of bands and arches are used to fix the mandible to the maxilla. If such fixation devices are used, they must have quick release capability or scissors (wire cutters) available in the event of motion sickness.

d. Hematologic Problems. Any problems in the blood oxygen carrying capacity may result in hypoxemia. A near normal HCT is always desirable. An acutely low HCT is tolerated less well at altitude than a chronically low HCT. As a general rule, if Hgb or HCT is sufficiently low (Hgb 7 Gm or HCT 21 percent), the patient should be given preflight transfusion until the HCT is at least 30 percent. In addition, supplemental O_2 should be

ordered. A cabin altitude restriction may be considered if indicated. Active bleeding must be controlled before a flight.

e. Orthopedic Problems. Fractures must be securely splinted or immobilized before a flight. The Collins (spring type) traction is the most desirable. Pneumatic splints are absolutely contraindicated because of changes in pressure or volume.

(1) **Casts.** Newly applied casts should be observed for 48 to 72 hours to allow the swelling to disappear and to make sure there are no circulatory problems. All casts should be bivalved if possible.

(2) **Weights.** Free hanging weights for traction are absolutely contraindicated. They should be disconnected and replaced with Collins traction during transport.

f. Spinal Column or Spinal Cord Injuries. Following stabilization, spinal cord patients should be moved to the nearest spinal cord center as soon as possible. The Stryker frame is ideal for such movements. The movement of such patients should be well planned and coordinated in advance. Traction with swinging weights is contraindicated. Collins traction should be used.

g. Ophthalmologic Problems:

(1) **Postsurgery.** Patients should be evaluated thoroughly before a flight for evidence of sufficient healing or resolution.

(2) **Patients with any acute problem to the retinal circulation (via retinal detachment, etc.)** must be provided supplemental O_2 .

(3) **The eye is essentially a fluid filled organ.** Surgery can sometimes introduce air into the globe. Altitude restrictions may be warranted in these cases.

h. Cardiovascular Problems. Cardiac patients generally do well in flight if provided supplemental O_2 . Hypoxia can precipitate angina or cause cardiac irritability with associated arrhythmias. These patients should be thoroughly evaluated before a flight and necessary supplemental O_2 and medications ordered. Patients with acute myocardial infarction should be stabilized before movement.

i. Pregnancy. The potential for premature birth in an uncontrolled environment must be considered. If evacuation is to be done after 240 days of gestation, it should be well coordinated. The patient should be accompanied by a trained professional if labor is imminent in the judgment of the attending obstetrician.

j. Psychiatric Problems. Unpredictable behavior of psychiatric patients could present a special hazard to other patients, the aircrew, and the pa-

tients themselves. If necessary, patients should be on a litter and restrained, with emphasis on "pharmacological" restraint and then physical restraint if indicated. Consider the aircraft environment at 35,000 feet and premedicate accordingly.

k. Burns. Patients with severe burns require the same intensive care in the air as they do on the ground. The aircraft environment may further endanger the burn patients because of dehydration and exposure to infection without proper preflight preparation. When possible, an experienced burn team should accompany a seriously burned individual. Before a flight the patient should:

- (1) Have a secure airway.
- (2) Have a tube in place.
- (3) Be well hydrated.
- (4) Be well medicated.
- (5) Be wrapped.

NOTE: Burn patients should be categorized as "urgent."

l. Pediatrics:

(1) Small Children. It is highly desirable for parents to accompany a small child to help care for and to reassure the child.

(2) Neonates. Because of their delicate respiratory and fluid volume status, these patients should be accompanied by a skilled neonatal transport team. Neonatal teams can significantly reduce the infant mortality rate in such situations. These patients are normally moved as urgent category patients.

m. Surgery. A week after surgery patients should be stable and not require IVs, tubes, etc. The DD Form 602 should clearly indicate the status of wounds, and appropriate care of such wounds.

n. Quadriplegic Patients. These patients are difficult to assess in-flight and, therefore, must be given a thorough preflight evaluation.

NOTE: Pay particular attention to the following: IVs, nasogastric tubes, tracheostomy tubes, catheters, and decubitis ulcers.

20. Wartime Aeromedical Evacuation (AE). The wartime AE environment is more austere, and suboptimal movements are often necessary. Because of the logistical limitations of battlefield medicine, each theater has developed an evacuation policy based on manpower and materiel limitations. If a patient cannot be returned to duty within the time frame designated by the theater surgeon, the patient may be aeromedically evacuated, regardless of his or her condition. Under such conditions, the availability of a bed for the next anticipated casualty may outweigh the need

for more definitive care; therefore, it is even more important to stabilize the patient as much as possible before movement. During wartime, dedicated aeromedical airlift may not be possible and the aircraft may be carrying other personnel and supplies. The problem of limited space, noise, and poor lighting are compounded in this situation and present a challenge for even the most experienced physician. However, the principles of peace-time AE can be applied equally well in wartime: Stabilize—select—preflight—transfer.

Section E—Medications, Diets, Supplies, and Equipment

21. General Information. Physicians and other health care providers at the originating medical facility must give careful, advanced consideration to the types and amounts of medications, special diets, supplies, and equipment required to support each patient during AE. Provisions must be made for all items to support the orders written on the DD Form 602. Medical crewmembers carry very limited medications and supplies (see paragraph 23). Medical equipment used in flight must be approved by the USAF School of Aerospace Medicine for safety and compatibility with the aircraft environment (see paragraph 24).

22. Items To Be Provided by Originating Medical Treatment Facilities:

a. Medications. Provide a 3-day (intratheater) or a 5-day intertheater supply of medications ordered on the DD Form 602. The exception to this is narcotics (see paragraph 23). Avoid packing medications in patient's luggage where they are inaccessible.

b. IV Solutions. Provide a 3- to 5-day supply of the type of IV solutions ordered on the DD Form 602.

NOTE: IVs must be freshly started, preferably with a well-secured intravenous catheter before a flight.

c. Hyperalimentation Fluid or Tube Feedings. Provide the directions for the formula used.

d. Special Diets.

e. Dressings. Provide adequate supply to reinforce burn dressings or those covering draining wounds. Dressings are not routinely changed in flight, only reinforced, due to the environment.

f. Drainage Bags—(such as colostomy bags for 3 to 5 days). Remember drainage can increase at altitude.

g. Fully Prepared Litter (as required). A fully prepared litter includes a mattress, pillow, pillow-

★c. Supplements/Tube Feeding/Infant Formula. Provide a 3-day (intratheater) or 5-day (intertheater) supply of commercial tube feedings not requiring refrigeration. Provide a 24-hour supply of all MTF-prepared tube feedings requiring refrigeration. Provide directions for administering formula to include commercial name, total cc, total calories, strength, and rate of flow. Provide missing instructions if necessary.

★d. Special Diets. Therapeutic diets will be provided by originating MTFs for patients who are added-on after regular scheduling has been completed. Therapeutic diets for all scheduled patients will be provided IAW AFR 166-6

by specified MTFs nearest the base where the flight originates. Order infant/pediatric diets for children under 3 years old by specifying a therapeutic diet requirement; e.g., "Diet for 1 1/2 year old." Provide infant formula as in paragraph 22c above.

e. Dressings. Provide adequate supply to reinforce burn dressings or those covering draining wounds. Dressings are not routinely changed in flight, only reinforced, due to the environment.

f. Drainage Bags—(such as colostomy bags for 3 to 5 days). Remember drainage can increase at altitude.

g. Fully Prepared Litter (as required). A fully prepared litter includes a mattress, pillow, pillow-

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case, two sheets, at least one blanket, and two litter securing straps.

h. Stryker Frame (as required). A 6- or 7-foot frame with all accessories, to include base anterior frame, armrests, footboards, etc. Parts are not always interchangeable. Wheels are removed for flight, but should accompany the patient attached to the frame base.

i. Leather Restraints (as required). For Class 1A and 1B psychiatric patients (applied for 1A and available for 1B).

j. Tracheostomy Tube, Plus Replacements (as required). A soft cuffed tube is preferred because of pressure changes in flight. Provide an additional sterile tracheostomy tube with inner cannula in case the tube is dislodged or requires replacement.

23. Items Routinely Available on Aeromedical Evacuation Missions During Peacetime: (For equipment details, see AFP 164-2 and MACR 164-3.)

- a. Humidified Therapeutic Oxygen. Mask or nasal cannula.
- b. Continuous suction.
- c. Collins traction (to replace swinging weights).
- d. Backrest (can elevate head of cardiac and respiratory patients 30°).
- e. IV fluid (extremely limited amounts). For

emergency use only.

f. Assessment tools (BP monitor, stethoscope, thermometer, otoscope, ophthalmoscope).

g. Ambu bag with adult and pediatric masks.

h. Needles—syringes.

i. Laryngoscope.

j. Routine Drugs. Limited number of routine drugs, such as Actifed, Afrin Spray, Aminophyllin, Ammonia Inhalants, Benadryl, 50% Dextrose, Epinephrine, Lasix, Nitroglycerine, Thorazine, Tigan, Tylenol, and Valium.

k. Emergency Drugs. Basic emergency drugs include limited amounts of Atropine, Digoxin, Isuprel, Lidocaine, and Sodium Bicarbonate.

l. Narcotics (in limited amounts). Narcotics available in flight are usually limited to Morphine Sulfate, Demerol injection, and Codeine tablets.

24. Items Available for Aeromedical Evacuation Missions, If Requested by the Originating Facility When Patient is Reported for Movement: (For specific information, see AFP 164-2.)

- a. Infant transport incubator.
- b. Oxygen analyzer.
- c. Cardiac monitor or defibrillator.
- d. Respirator or ventilator.
- e. Hypothermia blanket.
- f. Croup tent.
- g. IV infusion pump.

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SUMMARY OF CHANGES

This revision updates the entire text and constitutes a major rewrite. All chapters have been rewritten to accomplish specified actions. A checklist is included to improve patient preparation (atch 1). This revision is directed towards physicians and other health care providers at medical treatment facilities who select and prepare patients for aeromedical evacuation. The information, for the most part, applies during peacetime and wartime. Due to the broad scope of changes, users are encouraged to consult the text on each action.

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